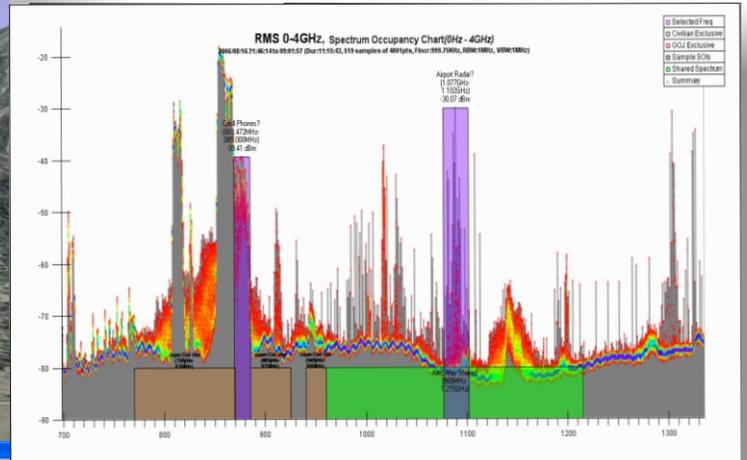
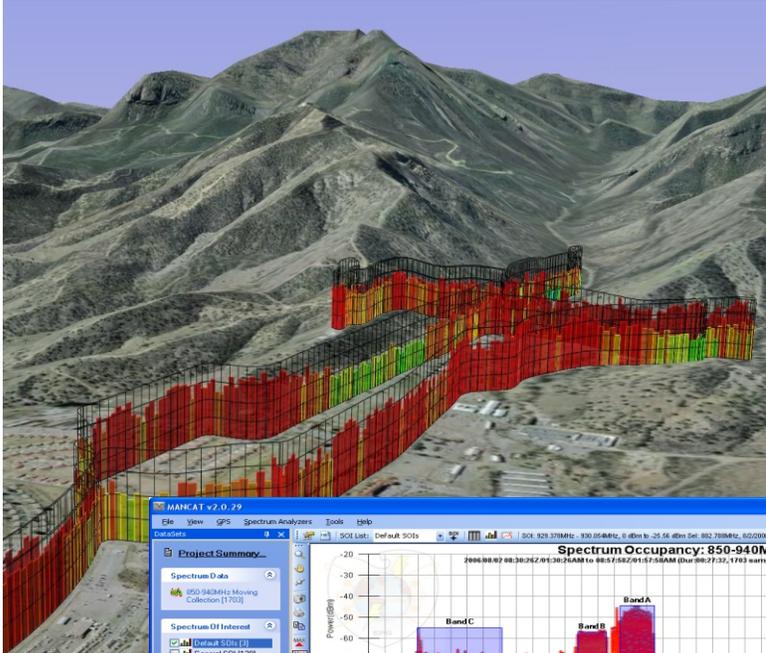




# ELECTRONIC PROVING GROUND

# ORION-MANCAT

## Multi-Spectral Ambient Noise Collection & Analysis Tool



**MANCAT v2.0.29**

File View GPS Spectrum Analyzers Tools Help

**Project Summary**

- Spectrum Data
  - 850-940MHz Moving Collection (1703)
- Spectrum Of Interest
  - General SOI (120)
  - Huachuca SFAP
  - Std Freq Bands [R]
- GPS Tracks
  - Track01

**Spectrum Occupancy: 850-940MHz Moving Collection**  
 2996.9882 88.3626Z 0E30.568M to 88.5532Z 0E31.573PM (dur:08:27.33, 1703 samples of 481pts, Freq:795.893MHz, BW:368MHz, VM:368MHz)

**Waterfall Chart: 850-940MHz Moving Collection**

**Spectrum Sweep: 850-940MHz Moving Collection**  
 Sweep: 1004, 08/02/06 08:46:43.134, Freq: 882.788MHz

**Duty Cycle: 850-940MHz Moving Collection, (882.788MHz)**

Status Satellites Heading Speed

Selected Frequency: 829.716MHz, Power: -25.56 dBm

**FSH6(90969128)**

90969128

Finished(5:49:27 PM)

Sample In - Swp Time:231.25ms(5:49:27 PM)

Sample In - Swp Time:246.875ms(5:49:26 PM)

Sample In - Swp Time:246.875ms(5:49:25 PM)

Sample In - Swp Time:231.25ms(5:49:24 PM)

Sample In - Swp Time:246.875ms(5:49:23 PM)

Sample In - Swp Time:231.25ms(5:49:21 PM)

Sample In - Swp Time:246.875ms(5:49:20 PM)

Sample In - Swp Time:231.25ms(5:49:19 PM)

Sample In - Swp Time:246.875ms(5:49:18 PM)

Sample In - Swp Time:246.875ms(5:49:17 PM)

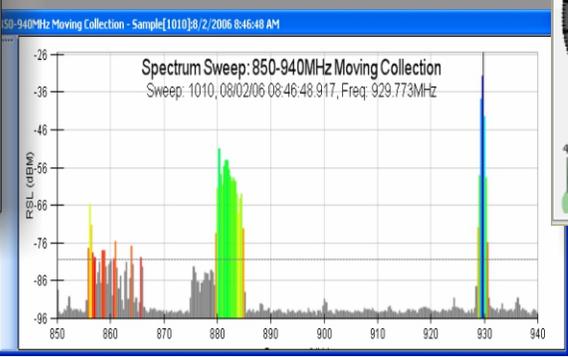
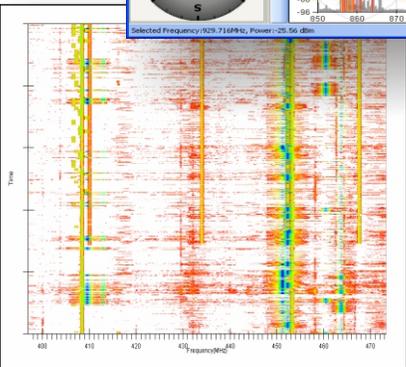
Starting Sweeps... (5:49:16 PM)

Reference Level set to: -25(5:49:16 PM)

Preamp On(5:49:12 PM)

Trace Detector set to: RMS(5:49:12 PM)

Initialized Control(5:48:49 PM)(5:48:49 PM)





# ORION - MANCAT ELECTRONIC PROVING GROUND

## MANCAT Overview

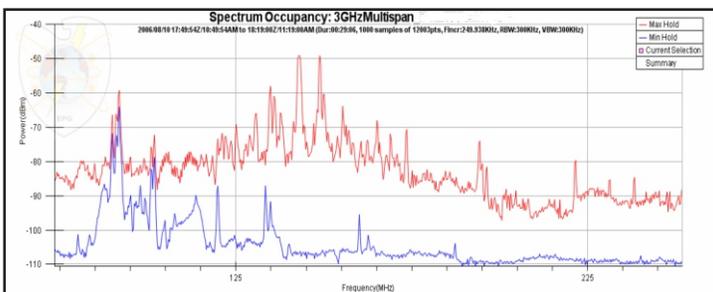
MANCAT is a tool for collecting and analyzing Radio Frequency (RF) Spectrum data. It collects this data from a variety of Spectrum Analyzers and provides an interactive, graphical environment for viewing and analyzing this data and generating report outputs.

## Operation

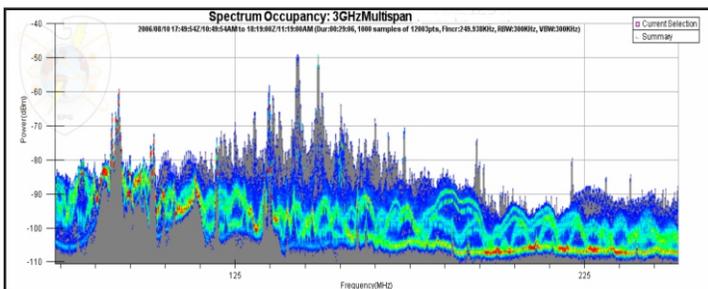
MANCAT interfaces with an assortment of spectrum analyzers and uses a XML based scripting language called XScript to automatically collect RF Spectrum Data. XML formats are used to record, store, import and export data. The data is then processed to generate interactive charts and other visualizations that provide the user with the ability to view the RF Spectrum at-a-glance or “drill-down” thru the data to view and analyze any portion of the spectrum they are interested in.

## MANCAT vs “Traditional” Spectrum Plots

Traditional spectrum plots relied on simple Max/Min hold line graphs to display a summary of the recorded data. This type of chart “hides” most of the data collected by the analyzer and gives the user no indication of the occupation of RF Spectrum.



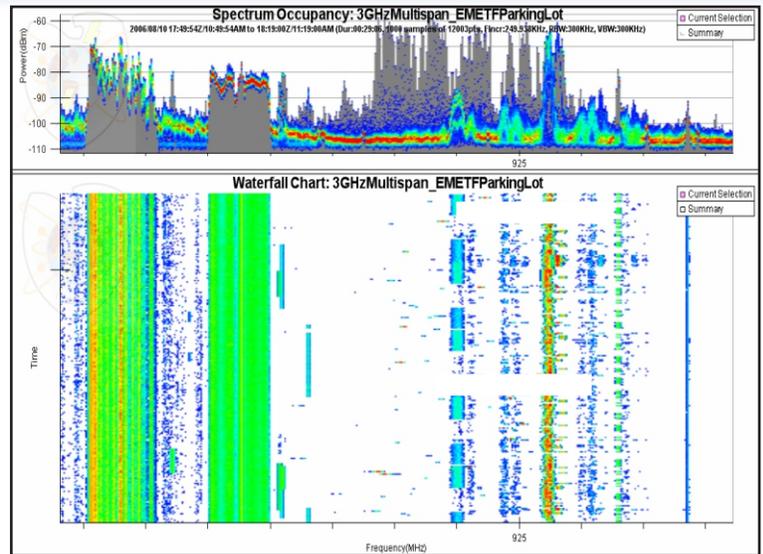
MANCAT's Spectrum Occupancy Chart, however, integrates all of the data recorded by the spectrum analyzer into a color-coded histogram that shows the distribution of RF energy as a percentage of the overall sample time.



This chart provides a great deal of additional information about how each frequencies energy is distributed, where warmer colors indicate a higher percentage of time spent at that power level.

## Waterfall Charts

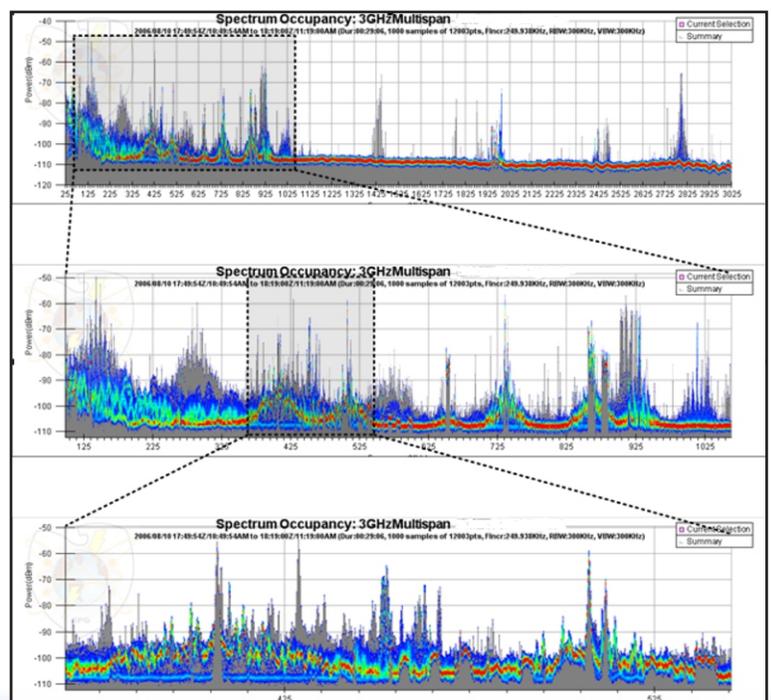
While the Spectrum Occupancy Chart is independent of time, the Waterfall Chart is used to show the activity across the spectrum over time.



In the Waterfall Chart, amplitude is shown with color. In the Waterfall Chart, Frequency vs. Time is plotted with power represented with color and where warmer colors indicate stronger signals. This visualization allows the user to see at-a-glance changes in the RF Spectrum over time. This also provides the user with an excellent tool for examining the interaction between signals and identifying related signals based upon a shared duty cycle, such as harmonics and intermodulation products.

## Zooming and Panning

One of the useful features of MANCAT is the ability to interactively zoom into the data and pan about the data by simply clicking and dragging the view with the mouse.



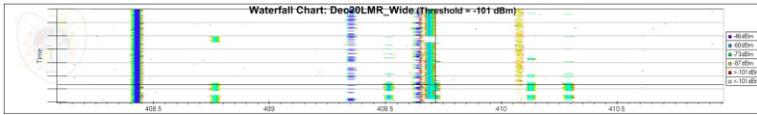


# ORION - MANCAT

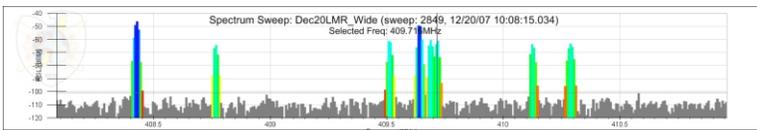
## ELECTRONIC PROVING GROUND

### “Drilling-Down” into the Data

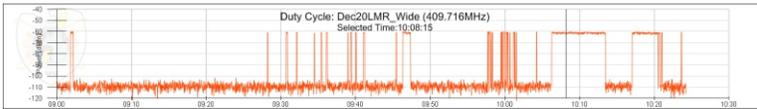
MANCAT offers the user the ability to “drill-down” into the data. By selecting a single point in the Waterfall Chart, the user is presented with a set of “cross hairs” that represent a specific Frequency and Time. The user can then analyze the data at the selected frequency and/or the data the selected time with a single push of a button.



The “Spectrum Sweep” chart represents the horizontal line of the “cross-hairs” showing the user the state of RF energy at that particular time across the frequency range shown in the Waterfall Chart.



The “Duty Cycle” chart represents the vertical line of the “cross-hairs” allowing the user to examine that particular frequency in the Time Domain.



### Frequency of Interest (FOI)

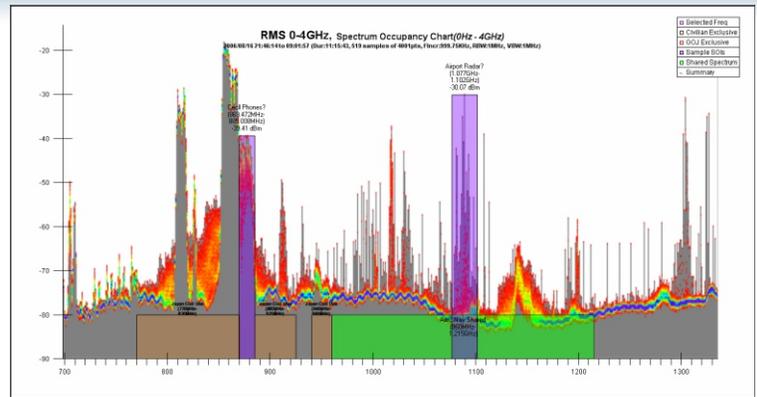
A powerful capability of MANCAT is the ability to identify certain parts of the spectrum that are of interest to the user. The FOIs (Frequency of Interest) are simply one or more frequency ranges that can have a unique power level associated with each frequency range. These could include but are not limited to:

- FCC Band Assignments
- Military & Commercial Frequency Assignments drawn from SFAF files exported from tools like Spectrum XXI.
- Key Test Item frequencies you would like to monitor
- Spread Spectrum Hopssets
- Protected Frequency Bands (FAA or Range Safety for example), etc

### Signal Finder

FOI Lists can also be created interactively by highlighting an interesting region of spectrum and adding it as a new FOI or automatically using the “Signal Finder” tool which automatically detects signals in the Spectrum Summary and generates FOIs for each detected signal.

FOIs can have optional names, geographic positions and descriptions associated with them. FOI's can be plotted as colored layers over the top of the Spectrum Occupancy Chart so as to correlate them with the measured data in order to identify unregistered interference, validate power levels, find unoccupied frequencies, etc.



### FOI Queries

If the user has a FOI list loaded into the MANCAT project, by selecting a single or a range of frequencies, the user can then query the FOI list to “lookup” any additional information about the frequency range contained in the FOI list by simply clicking a single button.

Source	RSL	Distance	Center...	Span	Power	Title	Description	Position	Frequency Range
Source: Huachuca SFAF - 115 Rem(s)									
-20.2dBm	4.2km	929.7 MHz	200Hz	94.0 dBm	SIERRA VISTA,AZ	Ser Net(102): FCC 2C7352 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 31 33...	929.6539MHz - 929.6739MHz		
-20.2dBm	4.2km	929.8 MHz	200Hz	94.0 dBm	SIERRA VISTA,AZ	Ser Net(102): FCC 2C7386 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 31 33...	929.7039MHz - 929.7239MHz		
-20.2dBm	4.2km	929.8 MHz	200Hz	94.0 dBm	SIERRA VISTA,AZ	Ser Net(102): FCC 2C7708 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 31 33...	929.7539MHz - 929.7739MHz		
-43.1dBm	58.1km	929.7 MHz	200Hz	94.0 dBm	VAIL,AZ	Ser Net(102): FCC 2C78EE (AgencyCndSvc(200,201,202): FCC Location: Lat: N 31 59...	929.6539MHz - 929.6739MHz		
-43.1dBm	58.1km	929.7 MHz	200Hz	94.0 dBm	VAIL,AZ	Ser Net(102): FCC 2C78FA (AgencyCndSvc(200,201,202): FCC Location: Lat: N 31 59...	929.7039MHz - 929.7239MHz		
-43.1dBm	58.1km	929.8 MHz	200Hz	94.0 dBm	VAIL,AZ	Ser Net(102): FCC 496CB9 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 31 59...	929.7539MHz - 929.7739MHz		
-43.8dBm	63.2km	929.7 MHz	200Hz	94.0 dBm	NOGALES,AZ	Ser Net(102): FCC 2C78B7 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 10...	929.6539MHz - 929.6739MHz		
-43.8dBm	63.2km	929.7 MHz	200Hz	94.0 dBm	NOGALES,AZ	Ser Net(102): FCC 2C78BC (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 10...	929.7039MHz - 929.7239MHz		
-43.8dBm	63.2km	929.8 MHz	200Hz	94.0 dBm	NOGALES,AZ	Ser Net(102): FCC 2C78BD (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 10...	929.7539MHz - 929.7739MHz		
-46.6dBm	86.9km	929.7 MHz	200Hz	94.0 dBm	TUCSON,AZ	Ser Net(102): FCC 2C78B2 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 10...	929.6539MHz - 929.6739MHz		
-46.6dBm	86.9km	929.7 MHz	200Hz	94.0 dBm	TUCSON,AZ	Ser Net(102): FCC 2C78F9 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 10...	929.7039MHz - 929.7239MHz		
-46.6dBm	86.9km	929.8 MHz	200Hz	94.0 dBm	TUCSON,AZ	Ser Net(102): FCC 496CB8 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 10...	929.7539MHz - 929.7739MHz		
-47.2dBm	93.2km	929.7 MHz	160Hz	94.0 dBm	TUCSON,AZ	Ser Net(102): FCC 2C286A (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 13...	929.739MHz - 929.7499MHz		
-47.2dBm	93.2km	929.6 MHz	200Hz	94.0 dBm	TUCSON,AZ	Ser Net(102): FCC 2C2P29 (AgencyCndSvc(200,201,202): FCC Location: Lat: N 32 13...	929.6039MHz - 929.6239MHz		

When one of the user’s loaded FOI lists is a list of frequency assignments in the local area, they can use this tool to quickly and easily identify the potential source of an RF “signal”. The resulting table of potential sources can then be sorted by power, distance, or even by anticipated Received Signal Level using a simple free-space RF Propagation Algorithm.

A user can also export this list of potential transceivers to a Key Hole Markup Language File (\*.KML) in order to visualize their placement on a map in the 3D Google Earth browser:

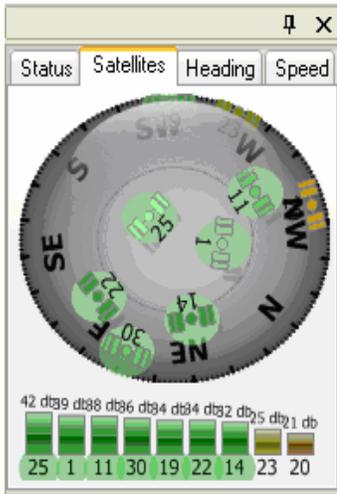




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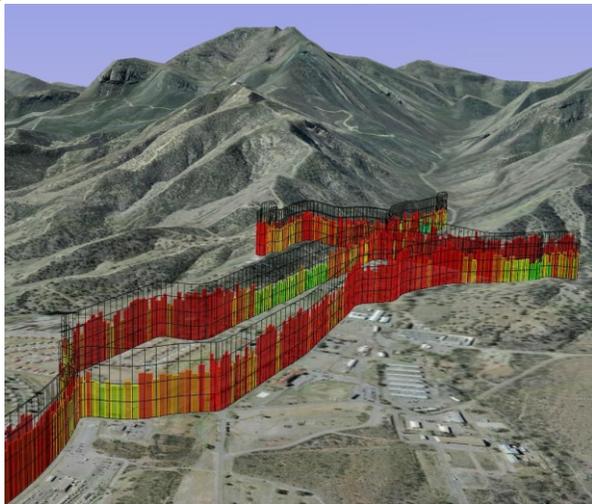
## GPS Data and 3D "Spectrum Tracks"

MANCAT will automatically detect and connect to any NMEA compliant GPS device attached to the computer and synchronize the system clock with GPS time to ensure all data collected is accurately time-tagged.



*The GPS window displays current position, satellite constellations, number of satellites "locked" and their link quality, as well as current heading and speed as well as allowing the user to record their position "track".*

When collecting data on the move the user can record their GPS position in the form of a "track" for integration with the spectrum data. Then by selecting frequencies in the waterfall chart, they can export 3D Spectrum Tracks into KML files for visualization in Google Earth.



Example of a 3D "Spectrum Track"

## Spectrum Collection Using Xscript

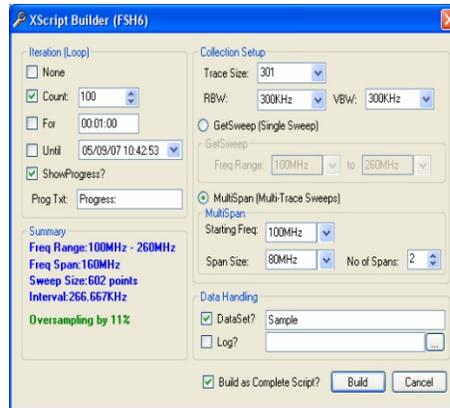
MANCAT uses its own extensible XML-based language called "XScript" to control Spectrum Analyzers and gather RF Spectrum Data. This allows MANCAT to drive multiple collection devices, each being controlled by its own script. XScript is easily extended to add new instruments, each one with its own custom language extensions as needed.

A unique capability that XScript offers is the "Multi-Span" mode where multiple "traces" of data from the instrument can be combined

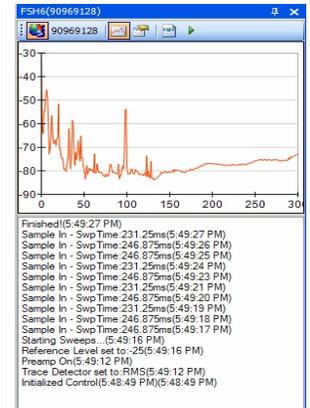
to cover large portions of the RF spectrum in a single view. This capability allows low-cost analyzers with small trace sizes (300-400 points for example) to combine their traces to create 12,000 point "sweeps" of broad bands of the RF Spectrum.

## Master Scripts

Master Scripts allow the MANCAT application to be automatically driven from XScript allowing for automated startup, connections to instruments, data collection, converting datasets and even generating reports on regularly scripted intervals.



XScript Builder



Collecting Data with XScript

## HTML Reporting

MANCAT can also automatically generate HTML reports from user configurable templates for RF Datasets. These reports include metadata and descriptions about the RF Datasets as well as "thumbnails" and high resolution Spectrum Occupancy and Waterfall charts. Using Master Script these reports can be automatically created as the data is collected and "pushed" to a web server to provide the spectrum data to a wide audience.

## Summation

MANCAT is an excellent tool for characterizing the RF environment across the spectrum. It can be used to monitor specific single frequencies of interest to the entire frequency range of the spectrum collection equipment used and then present the data using powerful visualization tools. MANCAT can correlate various Frequency of Interest (FOI) lists with empirically collected data, associate RF data with time-space-position information and generate various output products ranging from spreadsheets to 3D visualization of the data.

## Contact Information

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